MUST DO PHARM IN FOUNDATION PHASE

Watch the following topics from the recommended sources (Sketchy, Osmosis, Dirty Medicine on YouTube):

1. Cardiac Pharmacology:
    - Antiarrhythmics and Digoxin – Sketchy
2. Lipid-Lowering Agents:
    - Lipid-lowering drugs – Dirty Medicine (optional, if needed for clarification)
3. Endocrine Pharmacology:
    - Insulin – Sketchy
    - Oral hypoglycemics – Osmosis (recommended if you're unsure about the mechanisms of action)
4. Neuro/Psych Pharmacology:
    - Antipsychotics, Anticonvulsants, and Anti-Parkinsonism drugs – Osmosis (focus on MOA and side effects), MORPHINE
    - SSRIs and Atypical Antidepressants – Osmosis (focus on MOA and side effects), SNRI, TCA, Lithium.
5. Anesthetics:
    - General Anesthetics – Osmosis (MOA and side effects)
6. Renal Pharmacology:
    - Loop Diuretics, Thiazides, and Spironolactone – Sketchy
7. Immunology/Allergy:
    - Antihistamines – Osmosis

8 → Vancomycin, Metronidazole, Fluroquinolone, (Anti-TB) Tetracycline, (TMP-SMX) → Osmosis

→ ONDANSETRON → Pixorize.

Class 1 A.

Digoxin, milirinone, nesiritide

1. **DJ Foxglove: Digoxin – Derived from the foxglove plant**
2. Knocked over banana vending machine: inhibition NA+/K+ ATPase
3. Obstruction salty sodium peanuts: increased intracellular sodium as a result of Na+/K+ ATPase inhibition
4. Salty peanuts sneaking in the calci-yum ice cream: increased intracellular sodium promotes calcium influx at the NA+/Ca2+ exchanger
5. Flexed arm: increased cardiac contractility due the the positive ionotropic effects
6. Deflated heart balloon: symptomatic treatment of chronic systolic heart failure. Only used for symptomatic relief, does not decrease mortality
7. Las Vegas: direct stimulation of the vagus nerve allows for treatment of Atrial arrhythmias
8. Rhythm-inducing record: antiarrhythmics
9. Patients presenting will have HF and A.Fib, labs show elevated in K+

Adverse effects

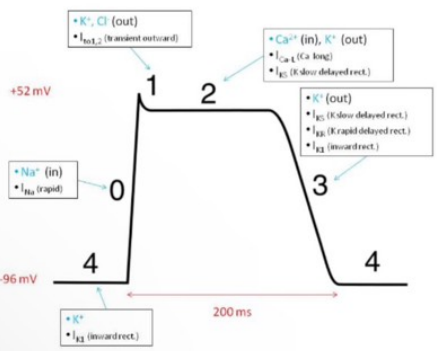
10. Pile of bananas: Hyperkalemia with acute digoxin toxicity
11. Various dances on the heart shaped dance floor: digoxin may induce various arrhythmias
12. TaSTy scoop: chronic digoxin use may cause scooped concave ST segments on EKG
13. SA music note: side effect of bradycardia due to parasympathetic activity of SA node
14. Dangling heart watch: side effect of bradycardia
15. Av MUSIC NOTE: SIDE EFFECT OF HEART BLOCk DUE TO DIGOXIN TOXICITY
16. Remain Unblocked: Digoxin is contraindicated in SA node heart block, or in use with caution in Beta Blockers
17. GI side effects include nausea, vomiting ,and abdominal pain
18. Yellow spotlight: side effect of Xanthopia (objects appear yellow)
19. Kid stuffed inside banana depleted vending machine: Hypokalemia will exacerbate digoxin toxicity
20. Loop diuretics can cause hypokalemia, along with diarrhea or vomiting may also occur
21. Kidney jukebox with long tapering flag on cracked kidney: Ren insufficiency can make digoxin toxicity worse and will precipit digoxin rise, the long flag indicates the long ½ life of digoxin, a increasing susceptibility to toxicity
22. Records in kidney jukebox: many arrhythmics inhibit renal clearance of digoxin, increasing susceptibility to toxicity
23. Fabulous: digoxin immune fab is used to reverse toxicity
24. **One in a million: Milrinone**
25. Don't phoster disinterest: milrinone inhibits phosphodiestera
26. CAMPaign: milirinone decreases CAMP breakdown
27. Flexing arms: milrinone increases cardiac contractility
28. Dilated red donkey ears: milirinon causes arteriolar dilation in HF, but watch for hypotension
29. **Turn the tide: nesiritide**
30. BuMP: BNP analog that increases cGMP
31. Dilated red ears and blue legs: nesiritide causes arteriolar anc venous dilation, reducing afterload and preload
32. Salty peanut stream: nesiritide causes natuiresis

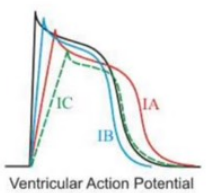
Digoxin

Antiarrhythmic Class I A-C (rhythm control): **No (Class I sodium)** Bad Boy (Beta Blockers) Keeps (Potassium) Clean (calcium)

1. Soloist: class I antiarrhythmics
2. Microphone stand Phase 0: of the AP upstroke dictated by Na+
3. Wire off the microphone is Phase 2: plateau dictated by Ca2+
4. Phase 3 downslope: repolarization dictated by K+
5. Soloist holding peanut jar: Class I antiarrhythmic block sodium channels
6. Soloist tipping mic stand: class I antiarrhythmics decrease the slope of phase 0 upstroke (slows conduction of the cardiac AP) AP will almost look tipped over with a decreased slope
7. Inactivating spoon in open peanut butter jar: Class I antiarrhythmics bind to open or inactivated Na+ channels.
8. Heart tipping mic stand: "use dependence" – class I antiarrhythmics have a greater effect on rapidly depolarizing tissues (increased heart rate causes slower phase 0 upstroke)
9. Potassium banana curtain: K+ current present during Phase 2 (plateau) and phase 3 (repolarization) of the cardiac action potential
10. Illuminated atria, ventricles, and His-perkinje system: class I antiarrhythmics affect the Na+ dependent cardiac action potential (no action at the SA and AV nodes)
11. Wide QRS shaped crack: class I antiarrhythmis widen the QRS complex on the ECG (decreased AP conduction velocity) this will happen when the HR increases because that will increase the effect of the drug
12. **Class IA antiarrhythmics: quinidine, procainiminde, dysopyramide "Double, Quarter, Pounder"**
13. **Dining prom queen: quinidine (class IA antiarrhythmic)**
14. **Prom King: procainamide (class IA antiarrhythmic)**
15. **"Disapears!" disopyramide (class IA antiarrhythmic)**
16. Binding strength: IC>IA>IB
17. Prom queen lightly holding peanut butter jar: class IA antiarrhythmics have an intermediate binding affinity to the Na+ channel (intermediate use dependence, moderate slowing of phase 0 upstroke) increased AP duration
18. Pushing away the curtain: class IA antiarrhythmics also block K+ channels prolonging phase 2 and 3 of the cardiac action potential → prolonged refractory period
19. Illuminated top and bottom of IA heart: class IA antiarrhythmics treat supraventricular and ventricular arrhythmias
20. White wolf pack: class IA antiarrhythmics treat WPW syndrome (a type of SVT involving extra signals in a accessory pathway)
21. Tin cans: quinidine toxicity can cause cinchonism (syndrome of tinnitus, headache, dizziness)
22. Broken plates: quinidine can cause thrombocytopenia
23. Prom kings lupus wolf: procainamide can cause a lupus – like syndrome raising an ANA titer
24. Darts in failing heart balloon: dysopyramide can exacerbate heart failure (negative ionotrophy)
25. Twisted torsades streamer: Class IA antiarrhythmics can cause Q-T interval prolongation (Precipitates torsades)
26. Whenever the potassium current is prolonged and thrown aside it can cause torsades de pointes (prolonged QT intervarl)
27. **Class IB antiarrhythmics "Lettuce, Tomato, Mayo"**
28. **Lied: lidocaine (class IB antiarrhythmic)**
29. **Friendly towing: Phenytoin (an anti-epileptic) that shows some type IB properties**
30. **Mexican flag: mexilitine (class IB antiarrhythmic)**
31. Dropped peanut butter jar: Class IB antiarrhythmic have a low binding affinity for the Na+ channel (low use dependence, modest slowing of the phase 0 upstroke) Decreased AP duration
32. Pulling the curtain: class IB antiarrhythmics shorten phase 2 and 3 of the cardiac action potential → shortened refractory period so no chance for torsades de pointes
33. Illuminated and cracked bottom of heart: Class IB antiarrhythmics treat ventricular arrhythmias (especially in ischemic tissues) in sodium channels spending more time in the open and resting state because of the longer action potential
34. Broken illuminated IB heart: has a greater tendency to work with ischemic heart because of the reduced resting membrane potential delays sodium channel transition from inactive back into resting state resulting in increased drug binding
35. "DEAD": class IB antiarrhythmics treat ischemia induced ventricular arrhythmias one of the most common causes of death in the acute period following an MI
36. Brain trucker hat: class IB antiarrhythmics cause neurological problems (parasthesias, tremor, convulsions)

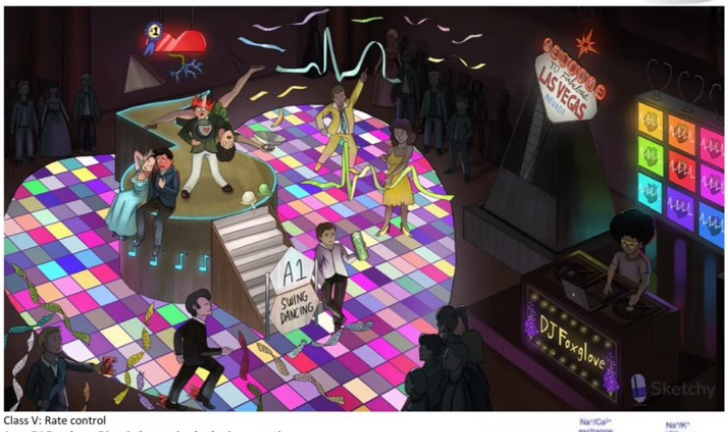
37. **Class IC antiarrhythmics Heart floor: propafenone, flecaoinide "Fries Please"**
38. **Flakes: Flecainide (class IC antiarrhythmic)**
39. **Purple phone: propafenone (class IC antiarrhythmic)**
40. Tightly held peanut butter jar: Class IC have a atrong binding affinity for the Na+ channel (strong use dependence, drastic slowing of the phase 0 upstroke) dramatic effect on QRS duration, prolongs ERP in AV node, no change in AP Duration
41. Untouched potassium curtain: class IC antiarrhythmic do not affect the cardiac action potential duration
42. Illuminated top and bottom of heart: class IC antiarrhythmics treat supraventricular (A.Fib) and ventricular arrhythmias
43. Irregularly Irregular signal: Class IC antiarrhythmics treat atrial fibrillation (and flutter)
44. Converting the signal: class IC antiarrhythmics can restore and maintain normal sinus rhythm in A. Fib and Flutter
45. "Healthy Hearts Only"!: class IC antiarrhythmics are contraindicated in patients with history of structural or ischemic heart disease (proarrhythmic effects)





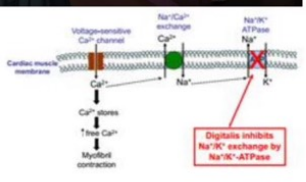
Ventricular Action Potential

- Class IA: e.g., quinidine
  - Moderate Na+-channel blockade
  - ↑ ERP
- Class IB: e.g., lidocaine
  - Weak Na+-channel blockade
  - ↓ ERP
- Class IC: e.g., flecainide
  - Strong Na+-channel blockade
  - → ERP



Class V: Rate control

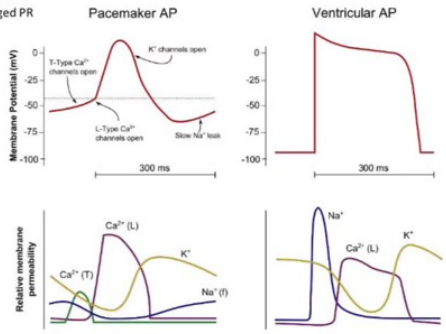
1. **DJ Foxglove: Digoxin has antiarrhythmic properties**
2. Vegas: digoxin exerts direct parasympathomimetic effects via direct stimulation of the vagus nerve → AV nodal inhibition
3. Irregularly irregulars signal: digoxin is useful in atrial fibrillation and flutter, not first line
4. Metronome: digoxin prevents rapid ventricular response in atrial fibrillation and flutter (rate control)
5. **Magnets: magnesium** is useful for the treatment of certain arrhythmias (torsades)
6. Torn twisted torsades streamers: magnesium treats torsades de pointes
7. Banana dancer pointing up: hyperkalemia can induce arrhythmia
8. Peaked streamer: hyperkalemia can cause peaked T waves (with shortened QT intervals) on ECG
9. Banana dancer pointing down: hypokalemia can induce arrhythmias, sever muscle weakness, and glucose abnormalities
10. Streamer with extra bump: hypokalemia can induce U waves at the end of the T wave on EKG
11. **Swing dancing: adenosine (a purine nucleoside with antiarrhythmic properties)**
12. Purine shaped gate: adenosine is a purine nucleoside
13. A1 swing: adenosine activated inhibitory AI receptors on the myocardium and at the SA and AV nodes
14. Banana flying out of the cup: activation of A1 receptors increases outward K+ current (hyperpolarizes, suppressed, Ca2+ dependent AP)
15. Falling calci-YUM ice cream: activation of A1 receptors suppress inward Ca2+ current
16. Note shaped dance floor: Adenosine inhibits AV nodes (decreased AV conduction, prolonged AV refractory period)
17. Hat blocking heart: Adenosine causes transient high grade heart block (direct av node inhibition for about 10s)
18. Disconnected bottom of heart: adenosine decreases atrioventricular conduction
19. Illuminated top of heart: adenosine is a first line agent for acute treatment of supraventricular arrhythmias (PVST)
20. Dilated coronary crown: adenosine causes coronary dilation (mediated by A2 receptors)
21. **Adverse Effects**
22. Flushed dancer: adenosine can cause cutaneous flushing
23. Dancer clutching chest: adenosine can cause shortness of breath, chest pain, and impending sense of doom
24. Fainting dancer: adenosine can cause fainting, headache, and hypotension
25. Energy drink blocking A1 gate: the actions of adenosine are inhibited by caffeine and theophylline (methylxanthines)



Adenosine

ass II (rate control) : Beta Blockers - No (Class I sodium) **Bad Boy (Beta Blockers)** Keeps (Potassium) Clean (calcium)

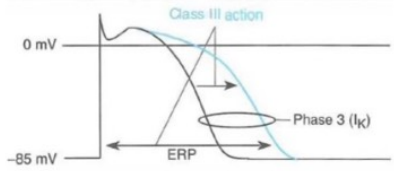
1. Duet: class II antiarrhythmics
2. Muted beta bugle: beta blockers (class II antiarrhythmics)
3. Notes: beta blockers treat arrhythmias by blocking sympathetic input to SA and AV nodes
4. Torn Band Camp: beta blockers decrease cAMP
5. Crushed calci-yum ice cream cartons: decreased cAMP leads to closure of membrane calcium channels, preventing the upstroke of AV nodal action potential
6. Phase 4: pacemaker current dictated by Na+ (funny current) and other ion. Depolarization is from Ca++
7. Phase 0: upstroke dictated bt Ca2+
8. Phase 3 repolarization dictated by K+
9. Sliding up the keys: beta blockers prolong phase 4 of the nodal action potential decreased pacemaker activity, prolonged conduction time and refractory period
10. Disconnected bottom of light: beta blockers decrease atrioventricular conduction
11. Heart light Lit up top: beta blockers treat supraventricular arrhythmias (Afib and RVR)
12. IVY: IV beta blockers (esmolol) can be used for acute supraventricular arrhythmias
13. Hat shielding heart: beta blockers can cause heart block
14. Public relations: heart block manifests as a prolonged PR interval on EKG
15. Irregularly irregular static signal: beta blockers are useful in atrial fibrillation (and flutter)
16. Metronome: beta blockers prevent rapid ventricular response in atrial fibrillation and flutter "rate control" but does not fix the atrial fibrillation



Class 2

lass III (rhythm control): No (Class I sodium) Bad Boy (Beta Blockers) **Keeps (Potassium)** Clean (calcium)

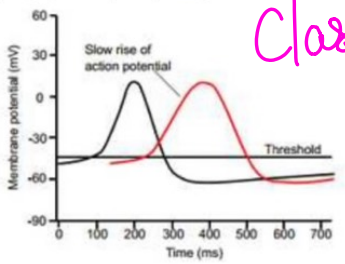
. Phase 2: plateau dictated by Ca2+
. Phase 3: repolarization dictated by K+
. Potassium banana theme curtain: K+ current present during Phase 2 (plateay) and Phase 3 (repolarization) of the cardiac action potential
. Singer pushing away the curtain: class III antiarrhythmics block K+ channels prolonging phase 2 and 3 of the cardiac action potential → prolonged refractory period
. **"uno, dos, tres, quattro": Amiodarone shares properties of class I, II, III, and IV antiarrhythmics.**
. **"till I die": –tilide suffix shared by dofetilide and ibutilide (class III antiarrhythmics)**
. **Soda: sotolol**
. Muted bugle and soda bottles: sotalol is also a beta blocker (lol suffix)
. Heart illuminated on top and bottom: class III antiarrhythmics treat both supraventricular arrhythmias and also ventricular arrhythmias
0. Irregularly irregular signal: class III antiarrhythmics treat atrial fibrillation and flutter
1. Converting the signal: class III antiarrhythmics can restore and maintain normal sinus rhythm in atrial fibrillation and flutter
2. **Adverse effects**
3. Skull brains: amiodarone has many neurologic side effects (tremor, ataxia, peripheral neuropathy, sleep disturbances)
4. Gray sunglasses: amiodarone can cause grey corneal deposits
5. Bog and small bowties: amiodarone can cause hyper or hypothyroidism, always evaluate thyroid prior to use and monitor during
6. Fibrotic lung embroidery: amiodarone can cause pulmonary fibrosis
7. Tight button: amiodarone induced lung fibrosis causes restrictive lung diseases
8. Trampled failing heart balloon: amiodarone can induce heart failure
9. Liver spot: amiodarone can cause hypersensitivity hepatitis (always monitor LFT's)
0. Grey blue outfits: amiodarone can cause gray blue skin discoloration
1. Flash photo: amiodarone can cause photo dermatitis
2. Broken chrome bumper: amiodarone inhibits the cytochrome P450 inhibition
3. Twisted streamer: sotolol, dofetilide, and ibutilide can induce dose related torsade's (although all type III antiarrhythmics can widen the QT interval)



Class 3

Class IV antiarrhythmics (rate control)- No (Class I sodium) Bad Boy (Beta Blockers) Keeps (Potassium) **Clean (calcium)**

1. 4 singers quartet: Class IV (rate control at SA and AV nodes) Non dihydropyridine calcium channel blockers
2. L shaped nozzles on wall: Block L type calcium channels in the heart
3. Nondairy: non-dihydroppyridine calcium channel blockers (class IV antiarrhythmics)
4. Delicious dark chocolate: Diltiazem (non-dihydropyridine CCB)
5. Very Vanilla: verapamil (non-dihydropyridine CCB)
6. Notes on music sheet: Exert a greater effect on tissues that fire more frequently that use a calcium current, non-dihydropyridines treat arrhythmias by blocking Ca2+ current in the SA and AV nodes
7. Keys leading up the piano as the gradual phase 4: pacemaker dictated by Na+ and other ions
8. Phase 0: upstroke dictated by ca2+
9. Phase 3: repolarization dictated by K+
10. Sliding up the keys: non-dihydropyridine CCB's prolong phase 4 of the nodal action potential → decreased pacemake activity, prolonged conduction time and refractory period
11. Disconnected bottom: non-dihydropyridine CCB's decrease atrioventricular conduction
12. Illuminated top: non-dihydropyridine CCB's treat supraventricular arrhythmias (A.FIB with RVR)
13. Public relations: non-dihydropyridine CCB's will prolong the PR interval
14. Hat shielding heart: Non-dihydropyridine CCB's can cause heart block, be careful when combining with other drugs that cause AV nodal blocking like digoxin
15. Irregularly irregular signal: non-dihydroopyridine CCB's are useful in atrial fibrillation and flutter
16. Metronome: non-dihydropyridine prevents rapid ventricular response in A Fib and Flutter



Class 4

Statin & Others.

Drug	Main Target
HMG CoA Reductase Inhibitors	↓ LDL
Bile Acid Resins	↓ LDL
Ezetimibe	↓ LDL
Fibrates	↓ Triglycerides
PCSK9 Inhibitors	↓ LDL
Niacin	↓ LDL ↑ HDL

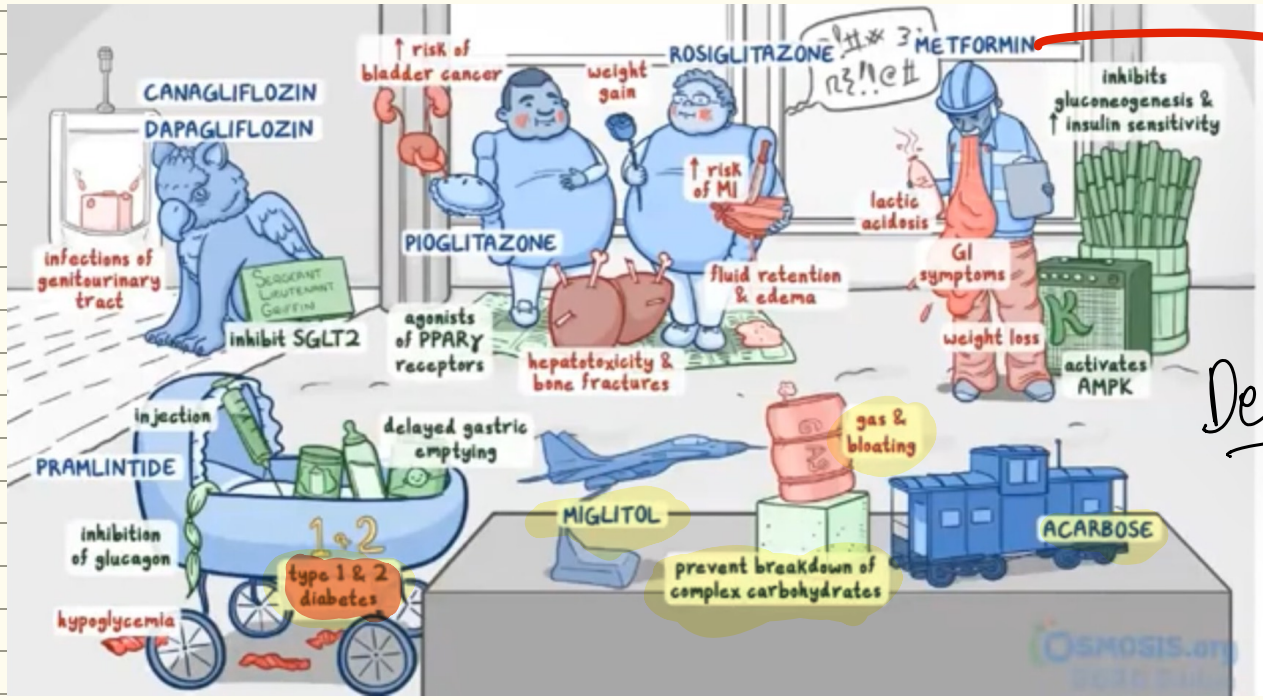
Diabetes: insulin, sulfonylureas, meglitinides, GLP-1 agonists, DPP-4 inhibitors (type I on this page)

1. Welcome inside mat: insulin (the storage and anabolic hormone of the body)
2. LangerHansel: islets of Langerhans in the pancreas (the site of beta cells in the pancreas)
3. Beta 2 tuba: pancreatic beta cells produce insulin (stimulated by many factors including glucose and sympathetic activation of beta 2 receptors)
4. Langerhansel candy: glucose – the most potent stimulant of glucose secretion
5. Closed gate around banana candy flowers: glucose increases ATP levels in the beta cell → ATP dependent K+ → channels close
6. Gretel rushing in on the calci-yum ice cream flower: closing the ATP dependent K+ channels causes the beta cell to depolarize → voltage gated Ca2+ channels open → Ca2+ INFLUX → insulin secretion
7. Candy wrapper on the ground: C-Peptide (cleaved from proinsulin in the secretory granule) is released with endogenous secretion of insulin
8. Tyrosine tire swing: the insulin receptor contains an intracellular tyrosine kinase domain, this sets off a cascade of phosphorylation events eventually leading to glucose transporters being added to the cell membrane
9. 4 on the open door: insulin inserts glucose transporter type 4 (GLUT4) into the membrane of peripheral tissues (adipose and muscle)
10. Full liver candy jar: insulin increase hepatic glycogen stores (increased glycogenesis, decreased glycogenolysis)
11. Glycogen glazed ham: insulin increases glycogen storage and protein synthesis in muscle
12. Full fatty donut jar: increases triglyceride storage in adipocytes
13. Old lady Eating banana candy: insulin decreases serum K+ (increased Na+/K+ ATPaase in skeletal muscle drives K+ into the cells)
14. **Girls and Lads**: Insulin Glusine, Aspart, Lispro (rapid acting, short duration) these do not polymerize into hexamers so they are absorbed rapidly
15. Tall immediate peak on "girls and Lads": Insulin glusine, aspart, and Lispro have rapid onset and short duration of action, mimicking post prandial response.
16. Birds nibbling the peak: insulin glusine, aspart, and lispro control the postprandial glucose spike
17. **Rest Now: regular insulin and NPH** (neutral protamine Hagedorn) Intermediate acting
18. Delayed peak on the house: regular and NPH insulin have a delayed onset and intermediate duration of action (NPH is more delayed) this is due to the formation of dimers and hexamers, taking time to breakdown
19. Ivy under "R": Regular insulin is only one to be administered IV
20. Candy Cane Key: Diabetic Keto Acidosis (DKA – Presents with vomiting, Fatigue, Polyuria)
21. Ivy next to candy key: IV regular insulin is useful in the management of DKA (watch K+ levels)
22. Ivy next to eaten banana: IV regular insulin is useful in the management of hyperkalemia (administer with glucose!)
23. **Rest Now: regular insulin and NPH** (neutral protamine Hagedorn) Intermediate acting
24. Delayed Peak: : regular and NPH insulin have a delayed onset and intermediate duration of action (NPH is more delayed) this is due to the formation of dimers and hexamers, taking time to breakdown, NPH is not used much clinically
25. **Don't Go: insulin Detemir, Glargine (long acting)**
26. Roof on hat is long and flat: Insulin detemir and glargine have long durations of action and provide a steady background level of insulin (glargine has no peak)
27. Falling candy: insulin therapy can cause hypoglycemia (presents with tachycardia, palpitations, sweating, nausea)
28. Glucagone for when your glucose is gone!

Type II diabetics

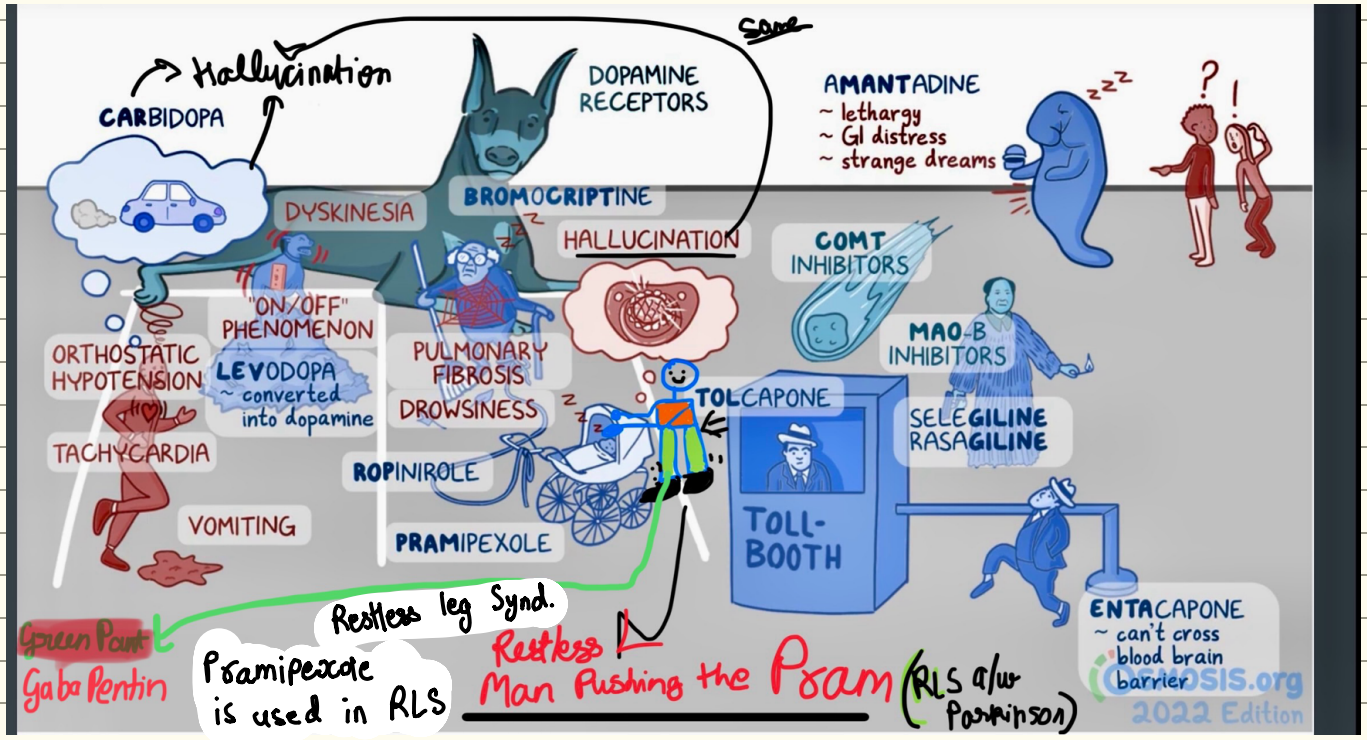
1. **Sulfa egg laying swan: sulfonylureas (glyburide, glipizide)** are sulfa drugs that stimulate endogenous insulin release from beta cells
2. Sulfa swan lake behind closed banana gate: sulfonureas bind the ATP-dependent K+ channels on beta cells → leading to depolarization of beta cells → calcium influx → release of endogenous insulin
3. **Mother swan in a maid outfit: "-amide"** suffix of first generation sulfonureas **(tolbutamide, chloropropramide)** long duration of action, rarely used)
4. **Goslings riding on the mother swan's back: "-ride" suffix** of second generation sulfonureas **(glyburide, glimepiride)** smaller dosing, long duration of action
5. **Short zig-zagging gosling: glipizide (2nd generation sulfonurea)** has the shortest duration of action (less risk of hypoglycemia)
6. **Father goose gliding into the scene: "glinide" suffix of the meglitinides (repaglinide, nateglinide)** MOA similar to sulfonureas sulfonureas bind the ATP-dependent K+ channels on beta cells → leading to depolarization of beta cells → calcium influx → release of endogenous insulin)
7. Candy wrapper on the ground: C-Peptide (cleaved from proinsulin in the secretory granule) is released with endogenous secretion of insulin
8. Father goose cannot lay eggs: meglitinides (glinides) are NOT sulfa drugs (can be used in patients with an allergy to sulfa)
9. Falling candy: sulfonurease and meglitinides can cause hypoglycemia
10. Fat old hag: sulfonureas and meglitinides can cause weight gain
11. "Do not drink" next to mother sulfonurea swan: some 1st generation sulfonureas (cloropramide) cause a disulfuram like reaction with ingestion of alcohol
12. These need functional beta cells in order to work
13. 2 fingers: sulfonureas and meglitinides (glinides) are oral agents used in the treatment of TYPE 2 diabetes requiring functional beta cells for endogenous insulin release
14. **ExenaTIDE detergent: "-tide" suffix of GLP-1 agonists (exenatide, liraglutide)**
15. Langerhansel "Gulp" activated when looking at Hag: GLP-1 agonists (exenatide, liraglutide) activate the Glucagon Like Peptide Receptor (GLP-1) (increased insulin release and satiety, decreasing glucagon release and gastric emptying)
16. **4 DRIPPNG laundry items hanging: Dipeptidyl peptidase (DPP-4) inhibitors (gliptins) prevent the breakdown of GLP-1**
17. Clipped in clothespins: "-gliptin" suffix of the DPP-4 inhibitors (stigaliptin, saxagliptin, linagliptin)
18. Laundering old hag letting out endogenous gulps: DPP-4 inhibitors (gliptins) increase levels of endogenously secreted GLP-1 (increased insulin release and satiety, decreased glucagon release and gastric emptying)
19. Falling empty glucagon packets: GLP-1 agonists and DDP-4 inhibitors decrease glucagon secretion this aids in lowering serum glucose levels
20. Sealed gastric container: GLP-1 and DDP-4 inhibitors decrease gastric emptying leading to increase satiety and delayed glucose absorption
21. Clothespin clipping nose: DPP-4 inhibitors (gliptins) can increase risk for upper respiratory infections an nasopharangyiis
22. Creping detergent lady Squeezing pancreas sponge: GLP-1 agonists (exenatide) can cause pancreatitis, seek immediate medical care
23. Green candies NOT falling off the tree: GLP-1 agonists and DPP-4 inhibitors do NOT cause hypoglycemia
24. 2 fingers: GLP-1 and DPP-4 inhibitors are oral agents used in the treatment of TYPE 2 diabetes requiring functional beta cells for endogenous insulin release
25. C-Wrapper: GLP-1 agonists and DPP-4 inhibitors increase endogenous insulin release and C-Peptide levels

Insulin & Other Hypoglycemics

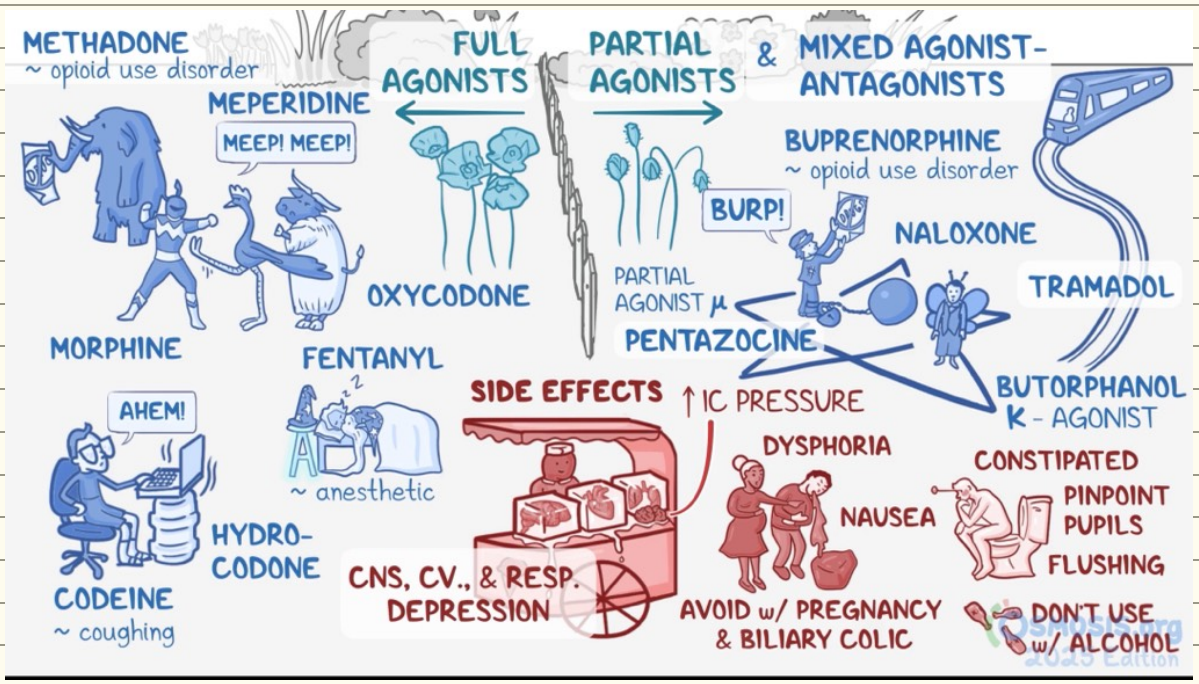


Also causes B12 Desiciency

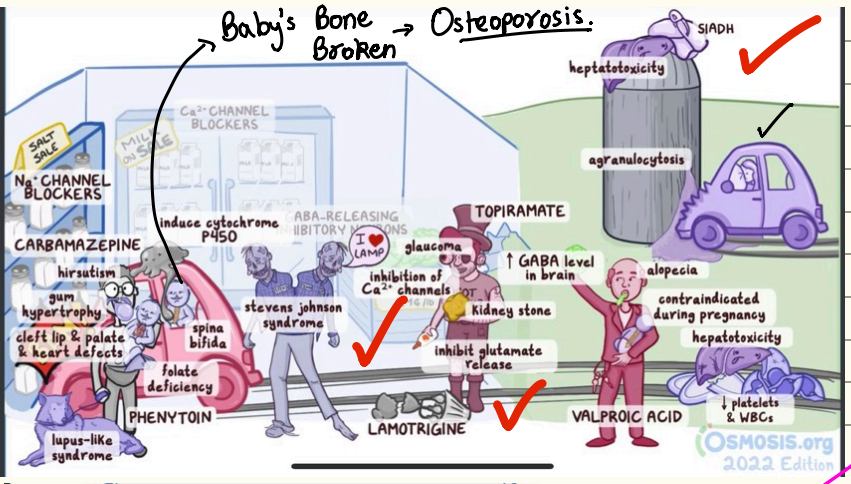
Anti-Parkinson Drugs.



OPIOIDS - Heroin is an Opioid.

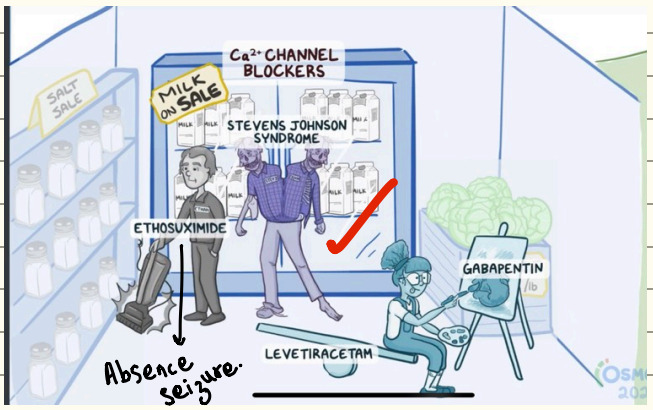


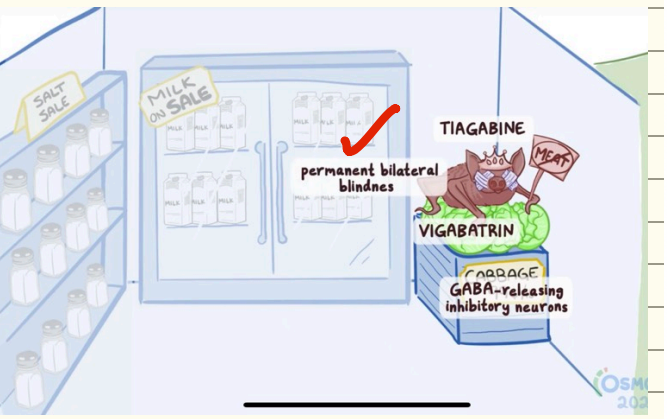
Baby's Bone Broken → Osteoporosis.

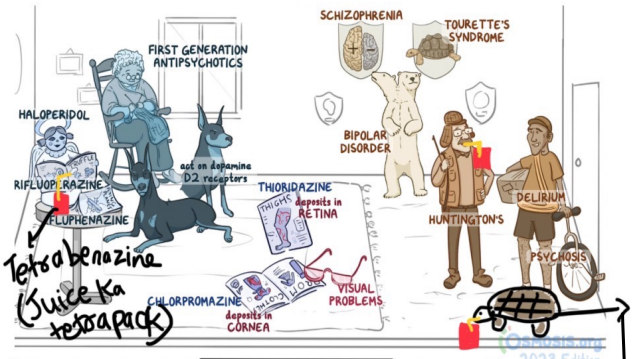


(Non BZD) ✓

← (Anti-convulsants.)







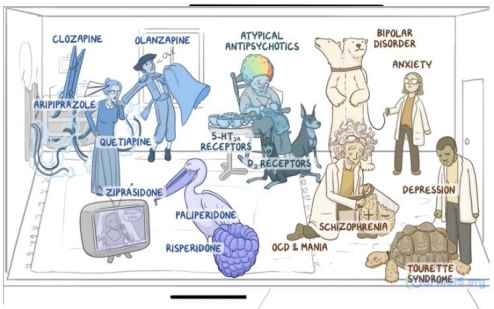
Tetrabenazine (Juice ka tetrapack)

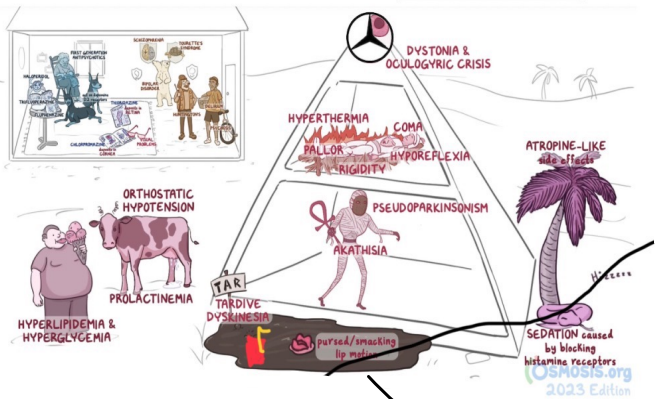
The Juice tetrapack

↳ Tetrabenazine

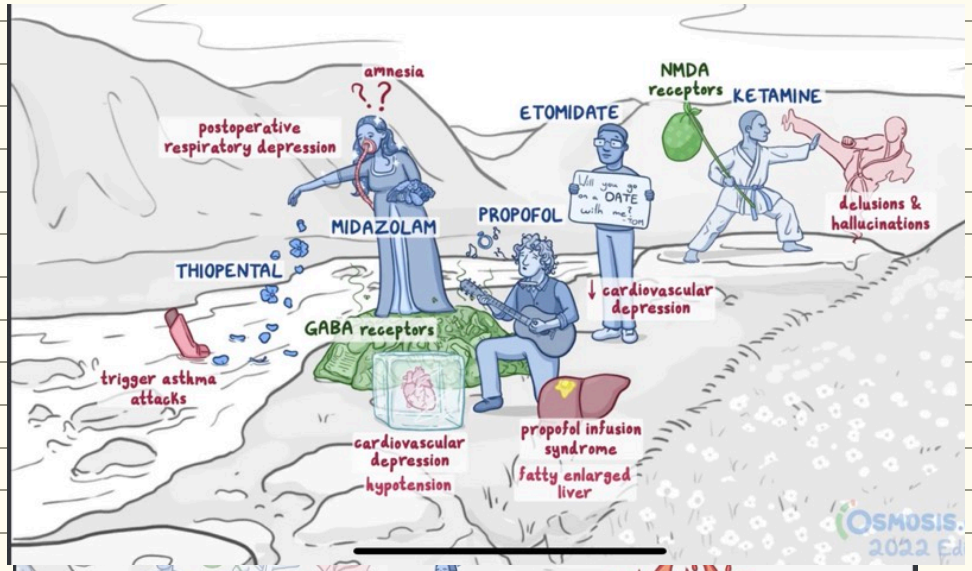
This tortoise is Tourette's Syndrome

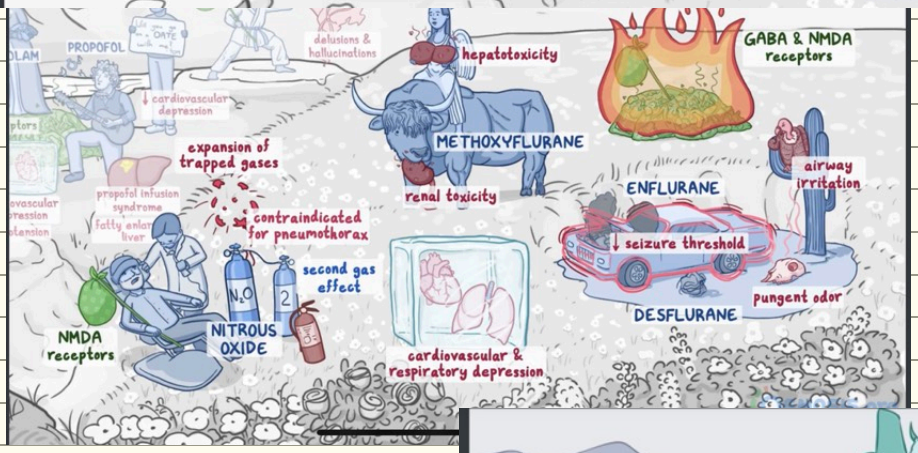
& tetrabenazine is the t/t



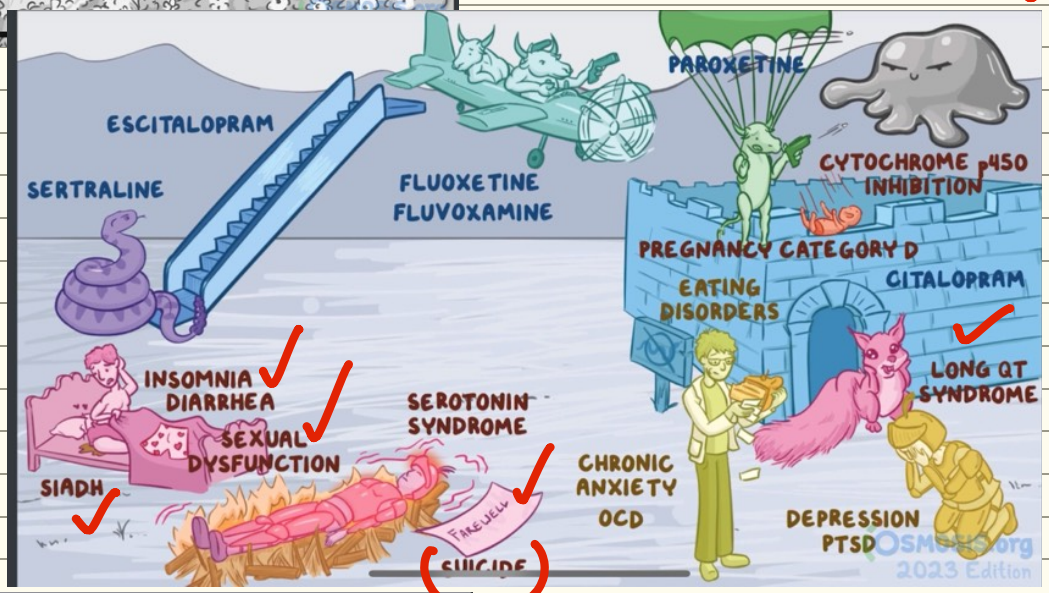


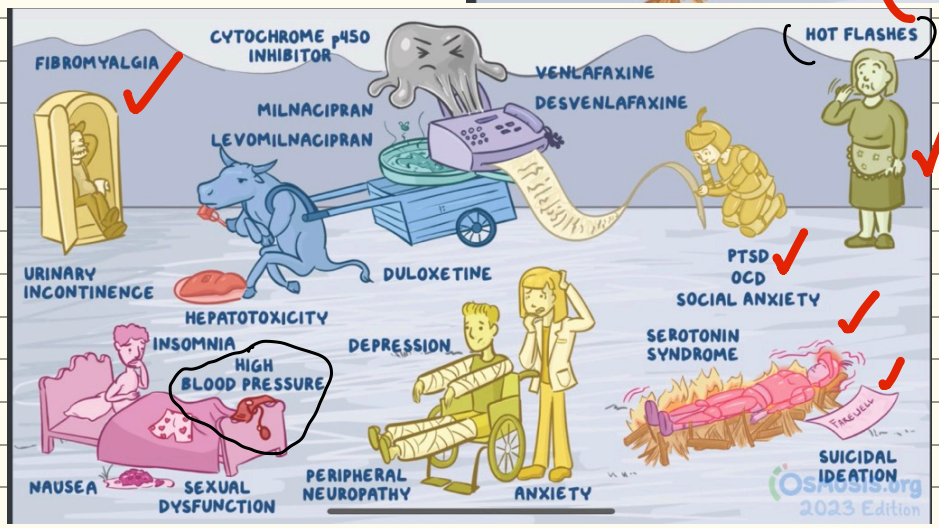
General Anesthetic



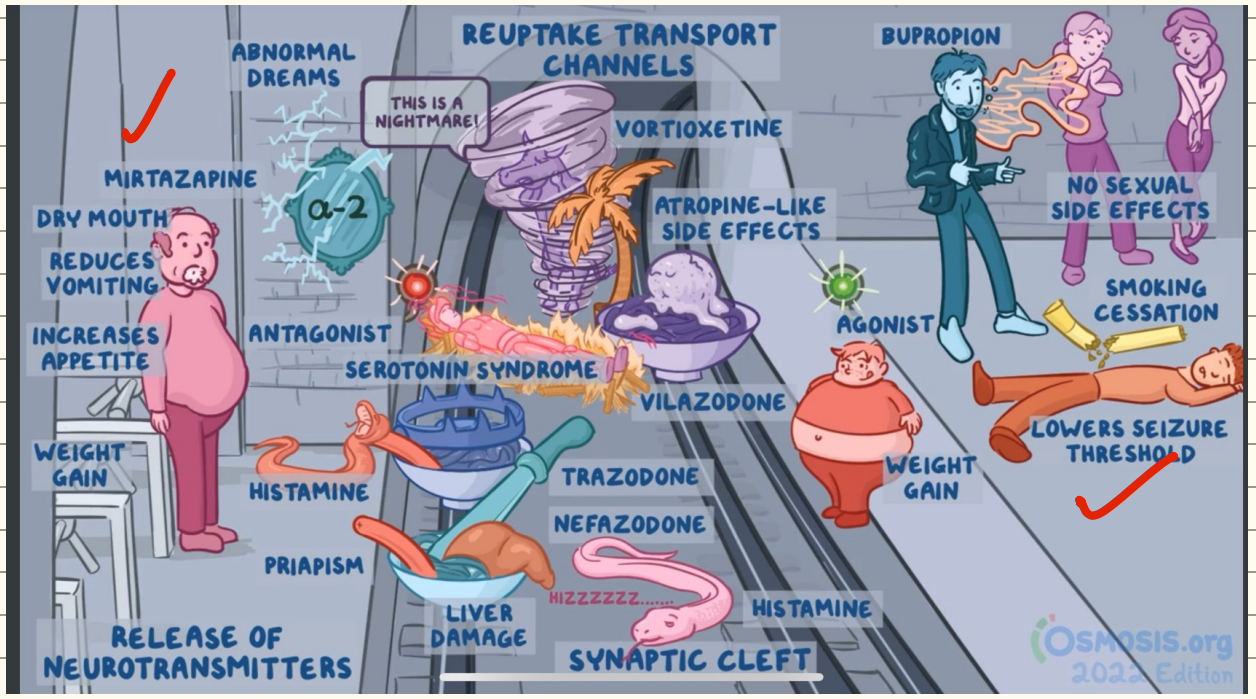


SSRI

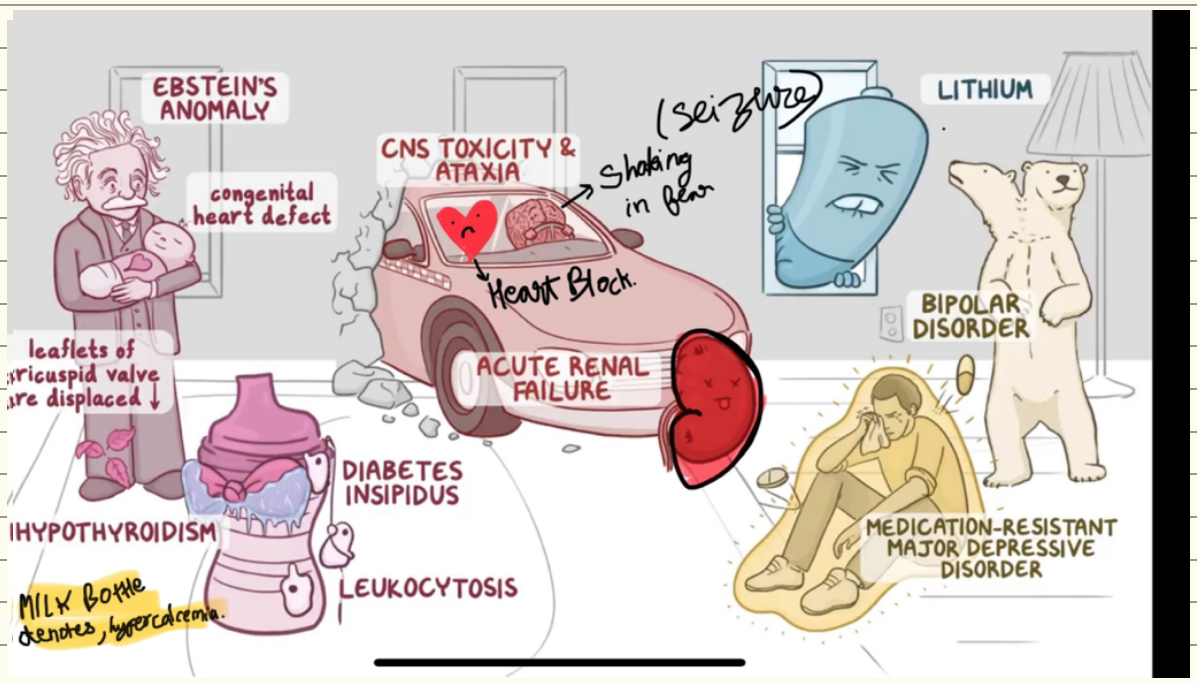




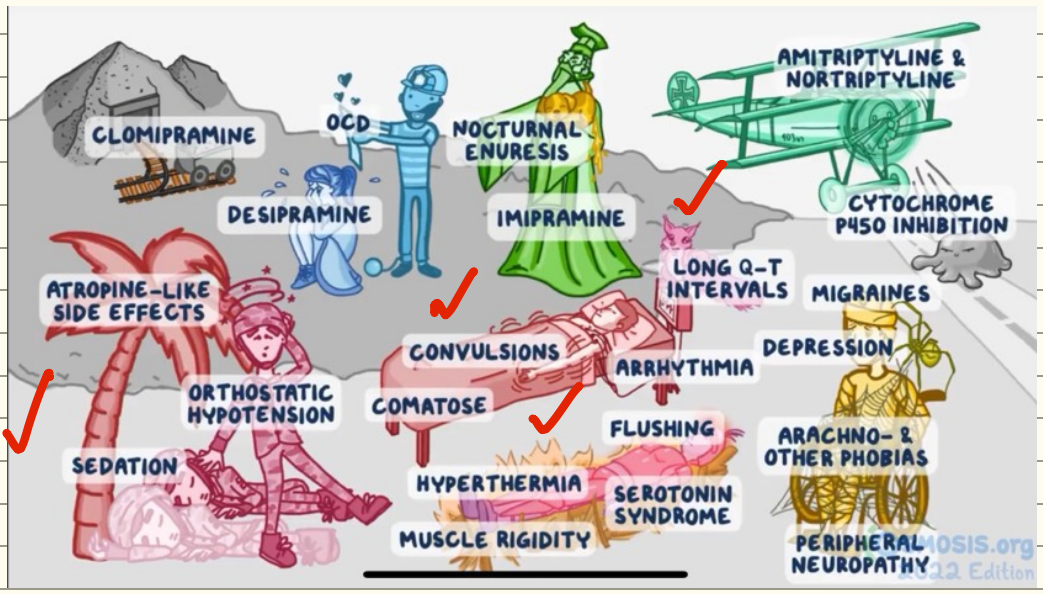
SNRI



Atypical Antidepress



Lithium.



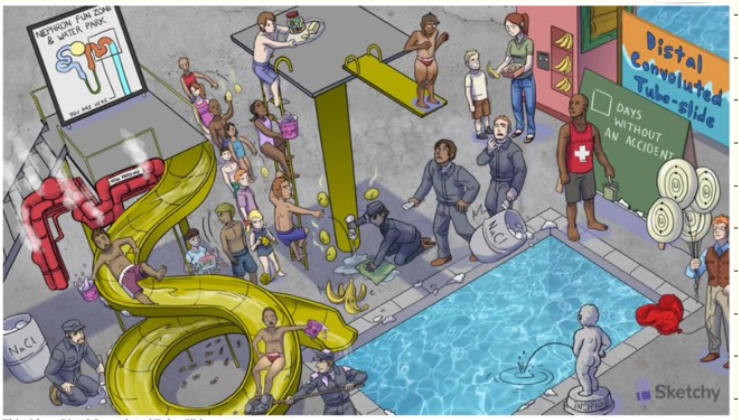
T.C.A.

Loop Diuretics

1. Loop de Loop of Henle: Loop of Henle
2. Thick ascending Limb of the loop of Henle: site of action of most loop diuretics. Most relevant is sodium chloride blocks
3. Banana vending machine: Na+/K+ ATPase on the basolateral membrane, that will pump sodium into the interstitium
4. Three P batteries: ATPase
5. Yellow track: lumen of the renal tubule
6. Platform: intracellular compartment
7. Background wall is the interstitium
8. Track worker taking peanuts, bananas, and 2 chloride packets: Na+/K+/2Cl cotransporter (NKCC) reabsorbs these ions at the luminal membrane of the TAL thick ascending limb
9. Water secured in car: the TAL is impermeable to water (diluting segment)
10. **Furious kid: furosemide (loop diuretics)**
11. Furious kid clinging to food: furosemide selectively blocks the NKCC transporter on the luminal membrane of the TAL, keeping sodium in the lumen in the tubule representing furosemides ability to reduce reabsorption of NaCl causing naturesis.
12. Loop diuretics are the most efficacious currently
13. **Ethics: ethacrynic acid (loop diuretic)**
14. Furious kid clinging to magnets and calci-yum ice cream: by blocking the NKCC, Loop diuretics reduce the lumen positive potential, promoting the excretion of Mg2+ and Ca2+
15. Falling magnets: prolonged use of loop diuretics can cause hypomagenesmia, especially in diet deficient patients
16. Falling calci-yum ice cream: Loop diuretics can cause hypocalcemia (rare)
17. **Pro-slugger: prostaglandins**
18. Furious kid wielding pro-slugger: loop diuretics induce the expression of COX-2, synthesizing prostaglandins that enhance salt excretion and dilate the afferent arteriole
19. Kid opening a path to afferent line of coaster: Prostaglandins will increase RBF in the afferent arteriole of the glomerulus. Thus enhancing diuretic action
20. Fire extinguisher inhibiting the pro-slugger: NSAIDs decrease prostaglandin synthesis, interfering with the actions of loop diuretics
21. Failing heart balloon: loop diuretics are 1st line for the symptomatic treatment of acute decompensated heart failure with fluid overload, reduction for peripheral or pulmonary edema
22. Wet lungs: Loop diuretics cause maximal amount of diuresis in the shortest amount of time. Used 1st line in acute heart failure with orthopnea that has crackles in the lungs and JVD. Loops will help with PRELOAD function. This will not help prolong the life of the heart.
23. Yellow inner tube: loop diuretics treat ascites in liver failure
24. High pressure pipes: loop diuretics can be useful in the treatment of HTN
25. Diuretics lower blood pressure by decreasing body sodium stores
26. Banana peel: loop diuretics are potassium wasting causing hypokalemia, hypokalemia can exacerbate any underlying arrhythmias in heart failure
27. Loud gong: loop diuretics can cause dose related hearing loss
28. Stinky sulfur eggs: most loop diuretics are sulfur drugs
29. Sulfa-less ethics: Ethacrynic acid is not a sulfa drug
30. Kidney filled with blue tickets: Interstitial nephritis can be caused by loop diuretics
31. Knitting needles: loop diuretics can cause hyperuricemia, may lead to gouty arthritis
32. Park employee cleaning the floor with contracted bleach bottle: loop diuretics can cause contraction alkalosis, causing dehydration and metabolic alkalosis by many mechanisms.

common interaction with Dig ⇒ yellow vision (any K wasting)

LOOP



Thiazides - Distal Convoluted Tube-Slide

1. Distal convoluted tube slide: Distal convoluted tubule
2. Distal convoluted tubule: site of action for thiazide diuretics
3. Banana vending machine: Na+/K+ ATPase on the basolateral membrane
4. Three P batteries: ATPase
5. Yellow tube slide: tubular lumen
6. Area outside slide: intracellular compartment
7. Sodium chloride salt scraper: NaCl cotransporter reabsorbs these ion at the apical membrane of the DCT
8. Active slider dropping the calci-yum ice cream: calcium is actively reabsorbed at the DCT (regulated by PTH)
9. **Chloro-thighs, thiodore Roosevelt on high dive: Hydrochloriathiazide and chlorothalidone (thiazide diuretics)**
10. Sodium chloride dumping into pool: thiazides inhibit NaCl reabsorption by blocking the NaCl cotransporter on the apical membrane (causing natiuresis)
11. Chloro-thighs kid dropping calci-yum: thiazide diuretic enhance calcium reabsorption, may be result at proximal and distal tubule. At the proximal tubule thiazide induced volume depletion leads to enhanced sodium and passive calcium reabsorption. At the distal tubule thiazides block sodium entry into the epithelial cell. This decrease of sodium entry enhances sodium calcium exchange at the basolateral membrane leading to the enhanced absorption of calcium
12. High pressure pipes: thiazide diuretics are one of the first line treatments for mild or moderate HTN
13. Loop diuretics are first line for acute, not thiazide
14. Floppy failing heart balloon: use of thiazides can be useful in the symptomatic treatment of heart fauilure (loop diuretics are first line)
15. Insipidus fountain: thiazide diuretics treat nephrogenic diabetes insipidus, thiazide diuretics can reduce polyuria and polydipsia in nephrogenic DI, and this paradoxical association is due to a hypovolemia induced increase in Na and H2O reabsorption in more proximal segments of the nephron where ADH is not working in the distal tubule. Thus allowing for more electrolytes to be retained.
16. Removing tube slide stones: thiazide diuretics can be used to prevent calcium stones (increased calcium reabsorption causes hypocalciurea) found in hyperparathyroidism, sarcoidosis,
17. New calcium chalk: thiazide diuretics may benefit patients with osteoporosis
18. Elevated calci-yum ice cream: thiazide diuretics can cause hypercalcemia
19. Elevated Candy jar and stick of butter: Thiazide diuretics can promote Hyperglycemia and also hyperlipidemia.
20. HIGHdroclorothiazide and the HIGH dive raises a lot of lab values
21. Yellow knitting needles: thiazide diuretic can cause hyperuricemia (can precipitate gout) due to hypovolemia and hyper absorption of urea
22. "Lift"ium balloons: thiazide diuretics decrease the amount of lithium cleared, therefore there will be increased serum lithium levels
23. Grey kid pissing in the pool: Lithium is a common cause of nephrogenic diabetes insipidus
24. Potassium depleted banana peel: Thiazide diuretics block the Na+/Cl+ cotransporter in the distal convoluted tubule, increasing sodium delivery to the collecting duct. This leads to increasing potassium secretion by the collecting duct in exchange for Na+ reabsorption leading to hypokalemia
25. Spilled peanut shells: thiazides diuretics can cause hyponatremia
26. Rotten eggs being tossed: Thiazides are sulfa drugs
27. Contracted bleach bottle: thiazides can cause contraction alkalosis, metabolic acidosis by hypovolemia induced renin production by the kidneys. Increasing aldosterone which causes increased H+ excretion at the collecting duct and more ATII leading to increased sodium bicarb reabsorption at the proximal convoluted tubule

Will increase aldosterone

Can lead to gout

THIAZIDES

K+ sparing Diuretics – Pt 1

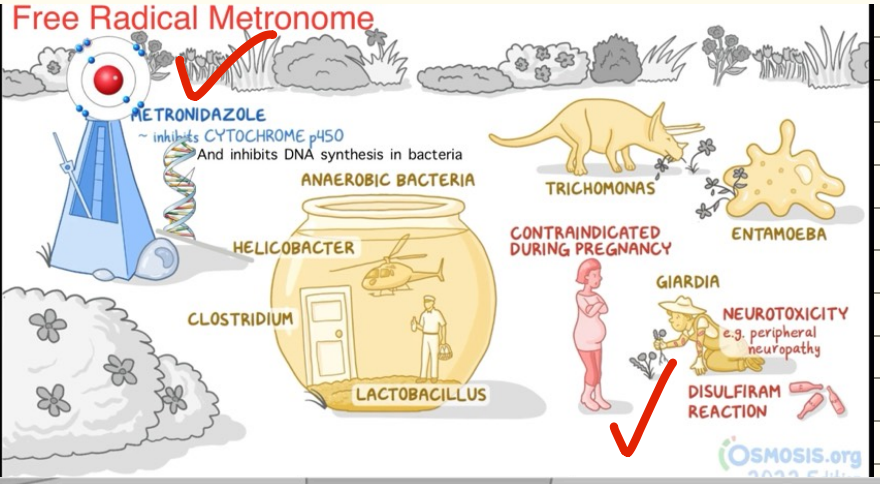
1. Central gutter: work in the collecting duct
2. Collecting duct (site of action of the K+ sparing diuretics)
3. Mineral-O-Food court: mineralocorticoids site of action (aldosterone) in the collecting duct
4. Principal court: principle cell of the collecting duct (major site of Na+/K+/H2O transport
5. Banana vending machine: Na+/K+ ATPases on the basolateral membrane, help pump reabsorbed sodium into interstitium
6. Three P batteries: ATPase
7. Food court ground: intracellular compartment
8. Salt-E sNaC cart: epithelial Na+ channels (ENaC) reabsorb Na+ across the luminal membrane of the collecting duct and distribute to the interstitium
9. Water in gutter: tubular lumen
10. Banana stand dumping bananas: K+ channels allow the excretion of K+ across the luminal membrane of the collecting duct
11. Salt-E sNaC care toppling banana stand: reabsorption of Na+ creates a negative luminal potential that facilitates K+ excretion, this is due to the negative electrical potential caused by the absorption of sodium into the interstitium that will draw the potassium into the tubular lumen
12. Alpha intercontinental food truck: alpha intercalated cell of the collecting duct (major site of H+ excretion)
13. Batter powered acid pump: H+ATPase on the apical membrane of the alpha intercalated pumps H+ into the lumen
14. Three P batteries: ATPase
15. Mineral court services: intracellular mineralcorticoids (aldosterone) receptor
16. Mineral key: aldosterone binds to the salt-E sNaCk upregulating ENaCs on the apical membrane, increasing Na+ reabsorption
17. Mineral Key activating the banana vending machine: aldosterone upregulates Na+/K+ ATPse on the basolateral membrane
18. Mineral key activating the banana stand: aldosterone upregulates K+ channels on the apical membrane, increasing K+ excretion
19. Loops and thiazides activate renin (and aldosterone) due to hypovolemia and cause a hypokalemia because they leave all of the sodium in the tubular lumen until it gets to the collecting duct. Then there is an attempt by the ENAC to retain all of the sodium at the expense of potassium, and facilitate H+ secretion causing a metabolic alkalosis.
20. **Tangerines: triamterene (K+ sparing diuretic)**
21. Tangerines blocking the salt-E sNaCk cart: triamterene inhibits Na+ reabsorption through ENAC
22. **Almonds: amiloride (K+ sparing diuretic)**
23. Almonds blocking the Salt-E sNaC cart: amiloride inhibits Na+ reabsorption through ENaC
24. Salty sodium peanuts falling into the duct: K+ sparing diuretics inhibit Na+ reabsorption at the collecting duct, promoting natiuresis
25. **Apple with the teacher: eplerenone (K+ sparing diuretic)**
26. Teacher with apple antagonizing the mineral court services man: eplerenone antagonizes the mineralocorticoid receptor
27. **Health inspector with Spiral bound notebook: spironolactone (a K+ sparing diuretic)**
28. Health inspector antagonizing the mineral court services man: spironolactone antagonizes the mineral corticoid receptor
29. Crumbling mineral mountain: K+ diuretics (spironolactone, eplerenone) are useful in the treatment of 1 and 2 hyperaldosteronism, conn syndrome, ACTH etc...
30. Failing heart balloon: K+ diuretics (spironolactone, eplerenone) are useful in the treatment of heart failure to prevent K+ wasting
31. Remodeling: mineralocorticoid antagonists (spironolactone, eplerenone) prevent myocardial remodeling induced by high level of aldosterone
32. Angel: mineralocorticoid antagonists decrease mortality in heart failure
33. Insipidus fountain: amiloride is useful in the treatment of Li+ induced nephrogenic diabetes insipidus, this will block lithium entry into collecting duct cells increasing clearance of lithium

17-fryer... can lead to gynocomastia

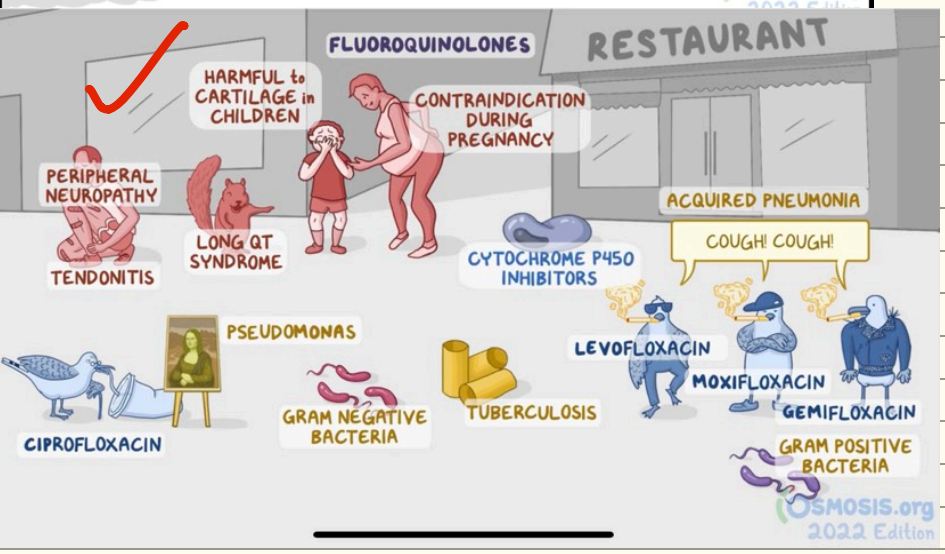
K+ Sparing Diuretics - CONT

34. Little gnome blocked by almonds and tangerines: amiloride and triamterene are useful in the treatment of Liddles syndrome (overactive ENaCs)
35. Elevated banana's: K+ sparing diuretics can cause mild or even dangerous hyperkalemia, seen in renal disease when there is a decreased excretion of potassium and with drugs that decrease renin and angiotensin activity such as Beta blockers and ACE inhibitors. Use a potassium wasting diuretic with these pts
36. Acid spill: K+ sparing diuretics cause a normal anion gam metabolic acidosis (by decreasing the function of the H+ATPase) by inhibition of aldosterone's effects at the collecting duct
37. Worker holding 4 acid tubes: K+ sparing diuretics inhibit the effects of aldosterone in the collecting duct causing a type 4 renal tubular acidosis
38. Big K: type 4 RTA is associated with hyperkalemia: this is the only one associated with hyperkalemia.
39. Spironolactone is much less selective with the aldosterone receptor, spironolactone is a synthetic steroid that can bind to other steroid receptors and processing enzymes. This has anti androgenic side effects and can block testosterone synthesis.
40. Fried male symbol: testosterone produced from cholesterol
41. Health inspector inhibiting 17 aplha "fry"droxylase: spironolactone inhibits 17alpha-hydroxylase. Important in the adrenal cortex and testes
42. Bubbling ovary shaped vats: spironolactone treats the symptoms of androgen excess in polycystic ovarian syndrome, used after a trial of birth control
43. Bushy beard: symptoms of androgen excess (hirsutism) in PCOS are treated with spironolactone
44. Preventing boy from receiving onion ring: spironolactone directly antagonizes the androgen receptor
45. Lids on chest: Gynecomastia caused by spironolactone
46. Droopy churro: Spironolactone can cause impotence and decreased libido

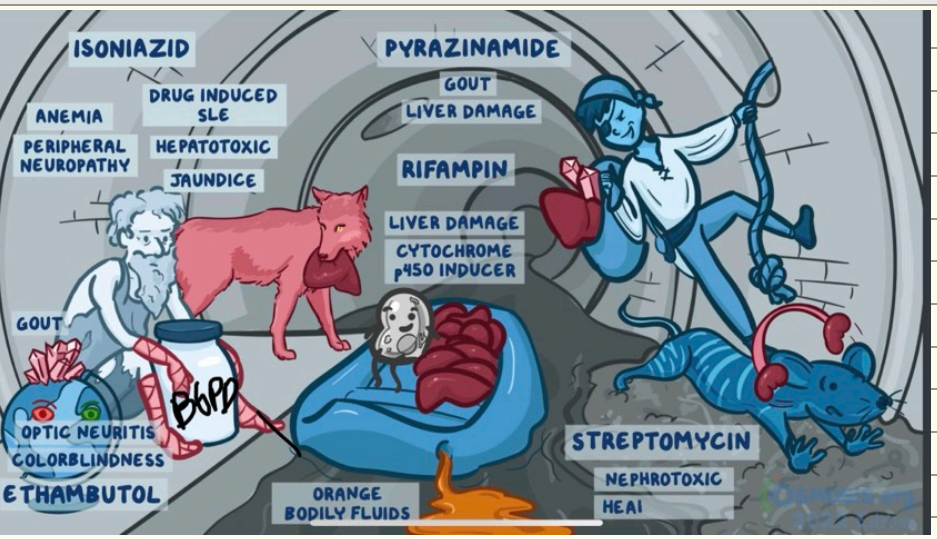
Spironolactone



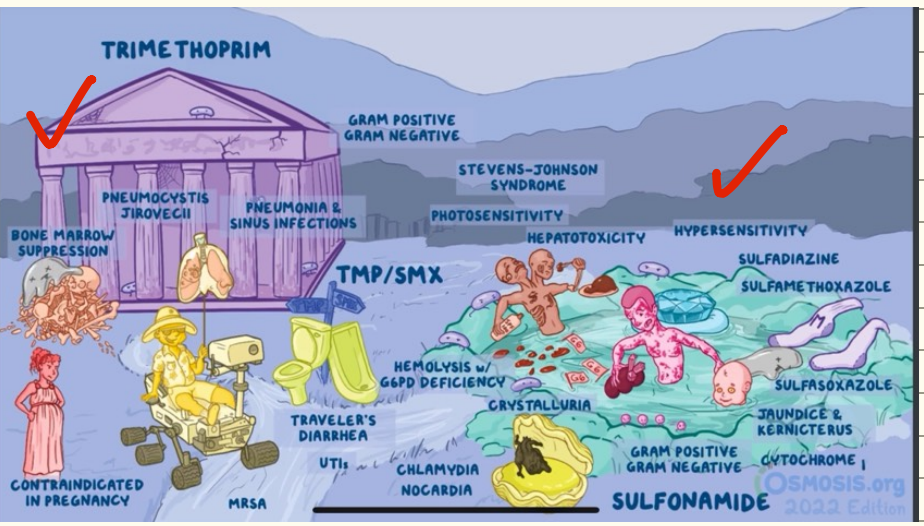
Metronidazole



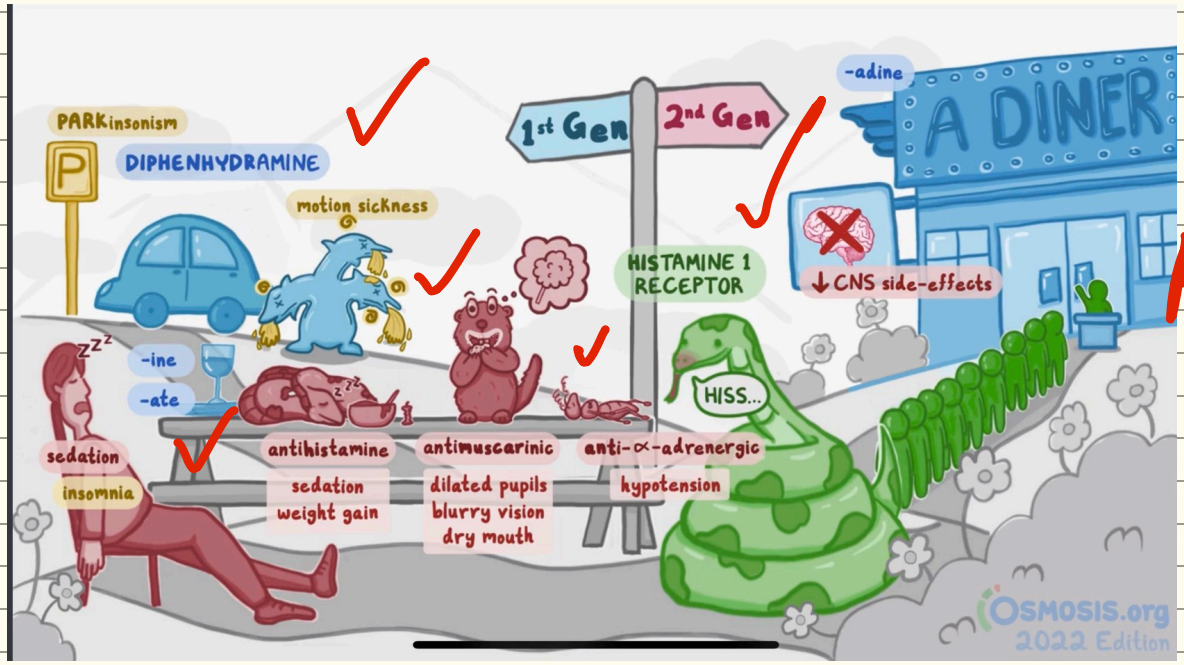
FLUOROQUINOLONE



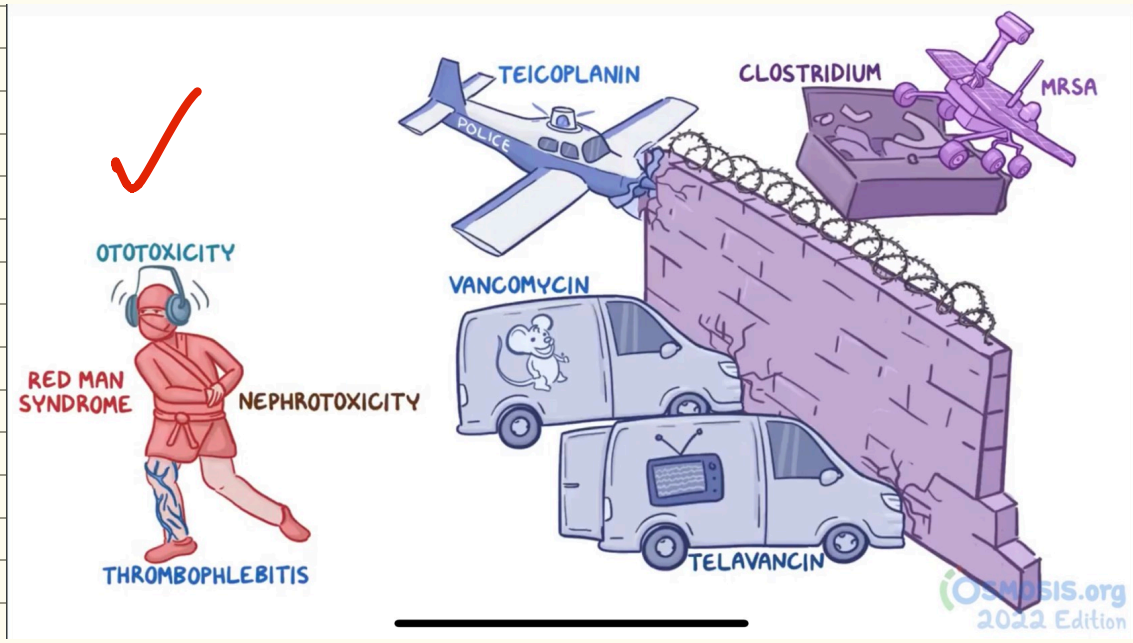
Anti-TB drugs.



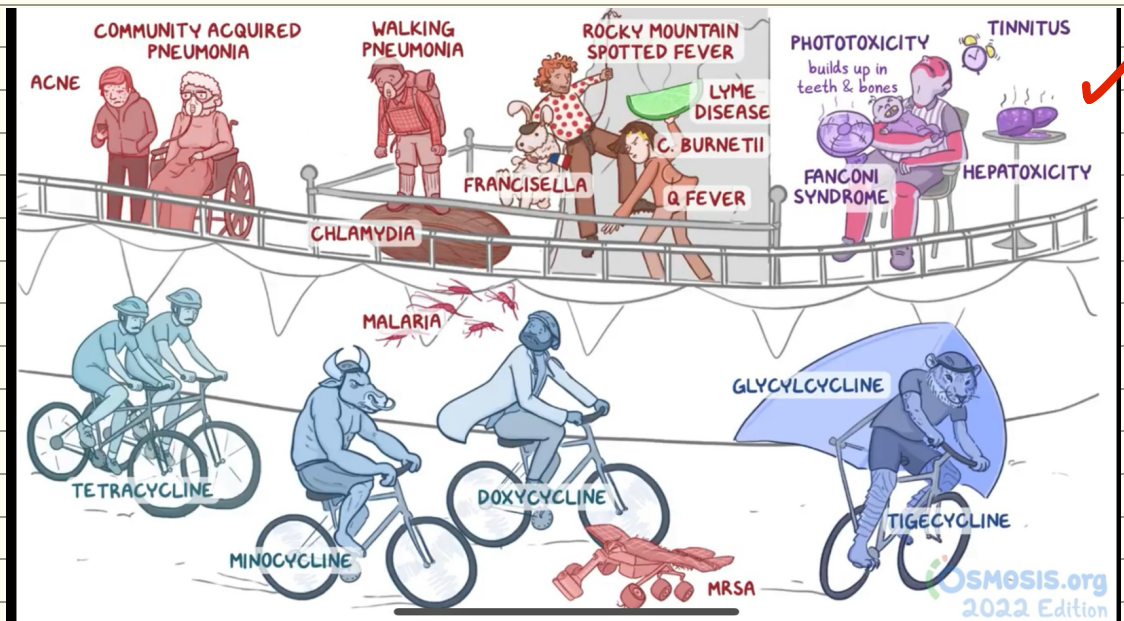
TMP-SMX



Anti-Histamine



Vancomycin.



Tetracycline


Pixorize
v1.0.0
GINGER ALE
(cute squirrel)
This is a QT syndrome
→Dance
(On dance Serson)
May Cause Serotonin Syndrome
(happy face = serotonin)
Wherever you see this
→it's a hint for QT syndrome.